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AND

REGISTER OF INVENTIONS AND IMPROVEMENTS.

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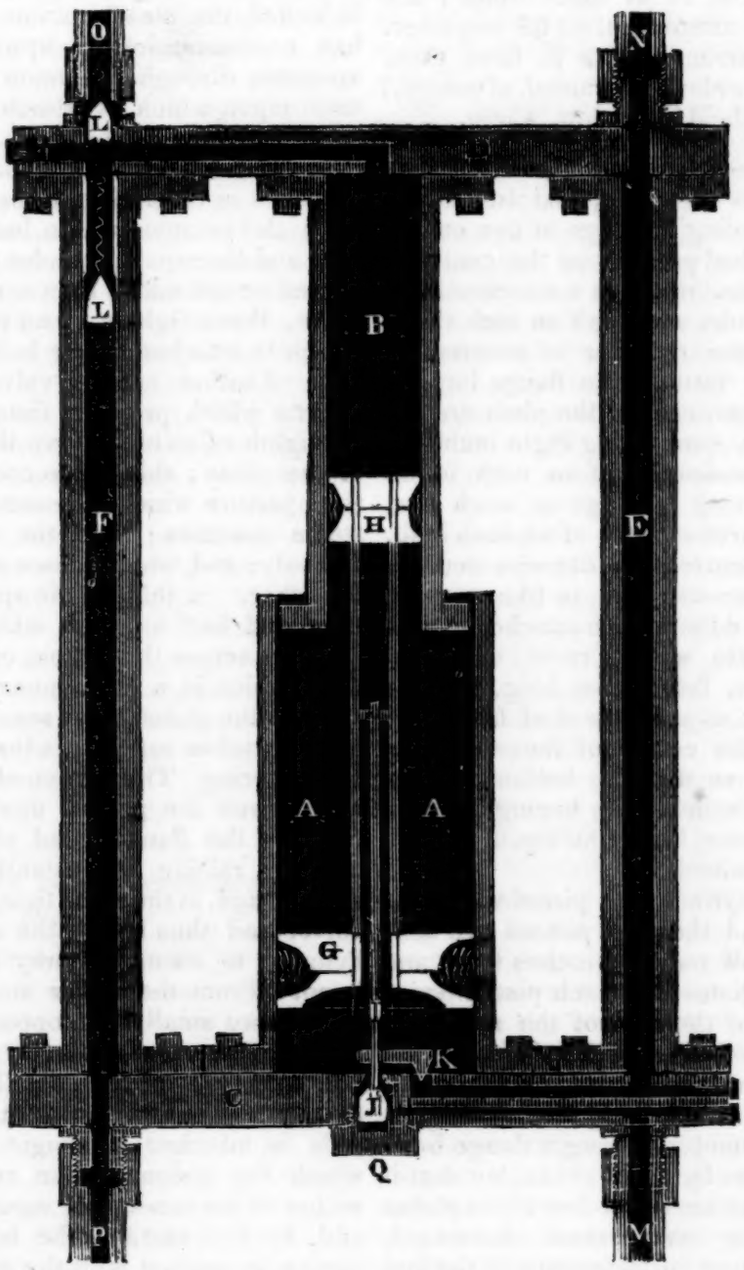
"An atheist must be a madman. He believes that effects can exist without a cause; and if this is not lunacy, it would be difficult to say what is."—[ANONYMOUS.]

SECTIONAL VIEW OF R. PORTER'S INDEPENDENT PUMP.



Explanation.—A A, interior of the steam cylinder; B, interior of the pump cylinder; C, bed plate; D, cap plate; E, steam column; F, water column; G, steam piston; H, pump piston, and head of the piston rod; I, valve rod, where it passes through the cross spring; J, induction valve; K, eduction or exhaust valve; L L, pump valves; M, steam pipe; N, exhaust pipe; O, suction pipe; P, injection pipe; Q, short screw, which closes the valve chamber.

Improved Forcing Pump.

To the Editor of the Mechanics' Magazine:

Sir,—Permit me to inform the public, through the medium of the Mechanics' Magazine, that I have recently constructed, and have now in successful operation, an improved forcing pump, which will invariably keep the boiler of a steam engine supplied with water, to a given and uniform height, without ever permitting it to rise above; acting independently of the steam engine, being operated directly by steam from the boiler; and keeps the boiler as well supplied, while the engine is at rest, and even while blowing off steam, as at other times; and that without any attention from the engineer. I have made arrangements to have them manufactured to order, (warranted, of course,) by Mr. D. Copeland, Hartford, Conn.

Specification.—A hollow cylinder, four and a half inches in length, and two inches in diameter, having a flange at one end, is placed in a vertical position on the centre of a horizontal plate, which is six inches long, three inches wide, and half an inch thick, and to which the cylinder is secured by screws, passing through the flange into the plate. On the two ends of the plate are two vertical columns, each being eight inches in length, and three-fourths of an inch in diameter; and having a flange at each end, and an orifice three-eighths of an inch in diameter in the centre, are likewise secured to the plate by screws; and, in like manner, the heads of the columns are attached to another similar plate which rests on them. Another cylinder, four inches long, and one inch in diameter, is also attached by flange and screws to the centre of the under side of the cap plate, so that the bottom of this cylinder comes within, and, having a flange of the requisite size, closes the top of the cylinder first mentioned.

Within each cylinder is a piston with suitable packing, and the two pistons are connected by a hollow rod, five inches long, and half an inch in diameter; each piston occupying one inch of the end of the rod, thus leaving a space of three inches between the two. Within the piston rod is a valve rod, three and a half inches long, and one-eighth of an inch in diameter, having a flange head at the top: not so large, however, but that it will pass freely within the hollow of the piston rod. The other end passes downward, through an aperture in the centre of the bed plate, into a valve chamber, which consists of an orifice of half an inch diameter, extending upward from the bottom of the bed plate to within an eighth of an inch of its upper surface, and being closed at the bottom by a short screw, which also has a cavity in the end, the better to accommodate the valve. From one end, and near the bottom of the bed plate, an orifice an eighth of an inch in diameter is drilled horizontally to the valve chamber. Directly over, and parallel to this, is another orifice, which extends nearly to the valve chamber, where it meets with a vertical aperture from the upper side of the plate. These orifices are both closed at the outward end, but the first has a vertical communication with a small steam pipe, which is attached by an union joint to the bed plate, directly under the column, (which is called the steam column,) and the other has a communication upward, by another aperture, through the steam column, to another pipe, which is attached to the upper side of the cap plate.

Several small apertures, nearly in contact with that in the centre of the bed plate, complete the communication between the steam pipe and the steam cylinder; and these are closed occasionally by a circular or conical valve, three-eighths of an inch in diameter, which is attached to the bottom of the valve rod. Another conical valve is attached to an arm which projects from the valve rod an eighth of an inch above the upper surface of the plate; this valve occasionally closes the aperture which communicates with the steam columns; thus, the same motion of the valve rod, which closes one valve, opens the other. A thin elastic spring, two inches long, and half an inch wide, extends horizontally across the bottom of the steam piston, (which is a little concave,) being fastened to the piston by a screw at each end; and the valve rod passes through the centre of the spring. Thus, when steam is admitted, and drives the pistons upward, the spring receives the flange head of the valve rod, and, by raising it, instantly shuts off the steam; and, at the same time, raises the other valve, and thus allows the steam within the cylinder to escape by way of the steam column. From the upper side of the steam piston, two small rods, opposite and parallel to each other, extend upward through the bottom flange of the small cylinder, and through the cap plate; to the heads of these rods is attached a weight or spring, by which the pistons, when relieved from the action of the steam, are again forced down; and, by this motion, the horizontal spring comes in contact with the exhausting valve, shuts it down, thus opening the other, which again admits the steam to the cylinder.

Two other pipes, (water pipes,) are attached by union joints to the two plates, the

one above and the other below the other column, which is called the water column, with which they communicate by apertures through the two plates. The cap plate is perforated horizontally from the aperture to the centre, thence downward, thus opening a communication between the water column and the small cylinder. Within the water column is a puppet valve, and above it, near the upper surface of the cap plate, is another; both of which are held to their seats by spiral springs, opening downward, so as to admit the descent, but prevent the ascent, of water through the column and pipes. (The whole apparatus may be inverted, however, which would preclude the necessity of spiral springs.) By this arrangement, when the pistons are moved down, the small cylinder is filled with water from the upper water pipe, which communicates with a reservoir; and when the pistons are moved upward, the water in the cylinder is forced down through the water column to the boiler. Thus, by the force of steam, emitted from the boiler by one pipe, water is injected by another. Another advantage is derived from having the steam pipe descend to the proper water line in the boiler; that whenever the water, by the injection of the pump, rises above said line, the water is forced up in the steam pipe, and thus chokes the valves and retards the motion of the pump, while the water, thus escaping, is forced through the exhaust pipe, which also terminates in the reservoir.

I claim as original the construction and arrangement of the plates, cylinders, columns, and valves; and the application of steam direct to operate a pump, as connected with the regulating principle derived from the descent of the steam pipe to the water line as above described.

RUFUS PORTER.

A Few Words in Behalf of Mathematical Science.

[From the London Mechanics' Magazine.]

MR. EDITOR,—Will you permit a foreigner (a Swiss) to make a few remarks on Mr. Cheverton's article on the value and importance of mathematical science.

In the first place I must state, that had it not been for the false aspersions he has heaped upon some of the most illustrious of my countrymen, and more particularly on that excellent man Euler, I should have left him to enjoy all the honors and benefits that may arise to him from the said article.

In the first observation he makes upon Euler, he says, "the most valuable method of determining the longitude was at last accomplished through practical means, and by practical men. Euler aimed to produce an achromatic lens as well as Dollond, but it was the latter who succeeded; and their respective modes of proceeding mark both the character and comparative value of their efforts."

Well, in all this there is, perhaps, nothing very extraordinary (upon the supposition that Mr. Cheverton's statement is true.) Euler belonged to that useless race of men called mathematicians (according to the Chevertonian philosophy), and Mr. Dollond (Mr. John Dollond I presume he means) was certainly a first rate optician; not only so, but *also* (much to his discredit, no doubt,) a clever mathematician, and an able astronomer.

Mr. James Gregory, professor of mathematics in St. Andrew's, as it appears from his "Optica Promota," showed how a telescope with specula might be constructed; but this unfortunate mathematician being neither an artist, nor having any turn for practical mechanics, was himself incapable of realizing his own invention by an actual construction, although he had demonstrated that to form a perfect image of the object the speculum must have the form of a parabola. I might here, Mr. Editor, pause to inquire whether the arts or science at this period were in advance; but the question would carry its answer along with it. The unfortunate Gregory could not find a single artist in his own country that could grind a speculum for him. Poor Scotland! this appears to be a stain upon your escutcheon. But why, it may be asked, did not Gregory apply to some of the English artists? The answer is easily given. They were not, at this period, one jot farther advanced in the arts than their northern neighbors.

Soon after the period just alluded to, the immortal Newton found himself compelled to relinquish for a time his philosophical pursuits, and betake himself to the mechanical art of grinding specula. His first attempt was to construct a reflecting telescope according to the principles of his friend Gregory, that is, with a parabolic speculum. In this, however, he did not succeed; but he succeeded in making two reflectors with his own hands, which he presented to the Royal Society in 1672, the great speculums of both being of a spherical figure, although he was fully aware of the superiority of the parabolic form. During the interval he was employed in making his reflectors, he tried his hands upon constructing a refracting telescope which had been prepared by Descartes, the object of which was to *grind the*

lenses into one of the figures of a conic section; and when employed in this pursuit, he made his grand discovery of the various refrangibility of the rays of light, from which he concluded, that the errors arising from the spherical figure of the lens were small in comparison with those which arose from refrangibility. He therefore gave up the attempt of constructing refracting telescopes, considering that the divergency of the rays of light, arising from the difference of their refrangibility, was always in proportion to the refracting powers of the medium. In consequence of this opinion of Sir Isaac Newton respecting refracting telescopes, all attempts to construct them free from the effects of refrangibility were, for a period of nearly seventy years, laid aside. However, some time about the year 1753, Mr. John Dollond, after many optical experiments, discovered that the refractions of two prisms, when made of different kinds of glass, might be equal, and that the difference of their refrangibility might be considerable; and that there might be equal divergency with different degrees of refraction; in short, that refraction might be produced without colors. Acting from these principles, Mr. Dollond was the first artist that produced a correct achromatic refracting telescope. And here I will ask Mr. Cheverton, if the odium, which he attaches to Euler on this head, ought not on all these accounts to have been fathered upon Newton?

I wait for his reply. I have lots more in store for him.

I am sir, yours, &c,

LEWIS FREND.

St. John's Wood, Aug. 9, 1834.

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A Few More Words in Behalf of Mathematical Science.

[From the London Mechanics' Magazine.]

Mr. EDITOR,—As I find I must be absent from London for two or three weeks, I will not have an opportunity during that time, of continuing my appeal in behalf of mathematical science; and as my last short article will hardly be a mouthful for your highly gifted correspondent, Mr. Cheverton, I beg leave to give him one morsel more before I take my departure.

LEWIS FREND.

St. John's Wood, Aug. 17, 1834.

Notwithstanding the opinion expressed by Sir I. Newton on the effects of refrangibility on the refracting telescope, Euler, it appears, (although a rigid disciple of the Newtonian philosophy,) was not satisfied; for we find that in 1747 he tried to prove the possibility of destroying the effects of colors on the focal image, by imitating the structure of the eye, which he considered to be the most perfect of all optical instruments.* He proposed to construct a convex lens, having its cavity filled with water, from which he expected to produce distinct vision, freed from the effects of refrangibility, and also from the aberration produced by the spherical figure of the lens. He, however, did not altogether succeed—in all probability for the same cause that Gregory failed. In truth, he was not a practical optician; pure intellect was the region of all his speculations. In 1752, Mr. John Dollond communicated to the Royal Society of London, a paper endeavoring to show that the principles advanced by Euler were quite at variance with those deduced from Sir I. Newton's experiments on the refrangibility of light; although, at the same time, it was doubtful if either the one or the other of their theories were consonant with the laws of nature. On this subject the scientific world were much divided in their opinions. At last Mr. Dollond, in order to satisfy himself, had recourse to experiments, the result of which was, that he found that he was wrong himself, and that Euler was right. Being thus cured of his former prejudices, although not liking the expedient of enclosing water in the lens, he at last, after four or five years of fatiguing research, succeeded in constructing an achromatic refracting telescope, in the way mentioned in my first article. And here, Mr. Editor, I cannot help thinking, that although Euler did not succeed, still the discoveries he made as to the method of destroying the errors arising from the effects of colors on the extremities of the focal image were the means of directing Mr. Dollond in his construction of the first refracting telescope, which he produced in the year 1757. However, be that as it may, he was more fortunate than Mr. James Gregory; he lived to see, and was one of the first to congratulate Mr. Dollond on his great achievement. He was too much of a sage to indulge in any peevish reflections on this seeming triumph of Mr. Dollond. Different was the fate of Mr. James Gregory: he did not live to see a construction of his reflector, according to his own principles, although Newton with his own hands had attempted it. However, in 1724, Mr. James Short, a first rate artist, and highly celebrated for his mathematical and astronomical at-

* I do not know what Euler's opinion on this head might have been 19 years afterwards, when, unfortunately for himself and science, he became totally blind.

tainments, succeeded in constructing a telescope according to the principles of the first inventor.

What Mr. Cheverton means when he says that the most valuable method of determining the longitude is by means of the telescope constructed upon the principles of Mr. Dollond, I am at a loss to guess. Does he mean that of finding the longitude at sea?* If so, I am compelled to inform him that he knows nothing about the matter. Hadley's reflecting quadrant and sectant, as improved by Ramsden's dividing engine, must rank as one of the greatest mechanical discoveries that ever was made in aid of nautical (or, I might add, practical,) astronomy. It is now universally used at sea for determining the longitude. While mentioning the names of Dollond, Short, Hadley, and Ramsden, those of Graham and Bird ought not to be forgotten; they equally distinguished themselves in their various mechanical and optical discoveries. The only charge that can be brought against them that can diminish their reputation in Mr. Cheverton's estimation, is that they were all more or less addicted to the useful studies of geometry and astronomy. Indeed, I have heard that one of them (whose name perhaps it would be improper to mention) indulged himself in the sinful practice of acquiring a knowledge of the higher analysis.

I shall have yet something further to say at a future opportunity; meanwhile, I beg to subscribe myself, Mr. Editor, your very obedient servant, LEWIS FREND.

History of Astronomy—its various Systems, &c. [Continued from page 220.

After the 20th of March the sun appears to rise every day sensibly more to the northward than he did the day before, to be more elevated at mid-day, and to continue longer above the horizon, till the 21st of June, which is the longest day at all places in the northern hemisphere. At this time the angle formed by the northern half of the earth's axis, and the line joining the centre of the earth and the sun, is then at the least, which is 66½ degrees. The sun will then appear to touch the tropic of Cancer, and be vertical to all places 23½ degrees north of the equator. This time of the year is called the *summer solstice*, because it is the middle of summer, and the sun seems to remain stationary for a few days.

After the 21st of June, the angle joining the centres of the earth and sun gradually increases, and the sun appears to recede from the tropic of Cancer, in the same manner as he advanced to it, rising every day a little farther to the south than he did the day before, till the 23d of September, when the axis has a similar position to what it had on the 20th of March, being again at right angles to the line just mentioned, consequently the days and nights are again equal all over the globe, which constitutes the *autumnal equinox*.

The sun now appears to cross the equinoctial; and the south pole, which, during the last six months, was in the dark, begins to turn towards the sun; and precisely the same phenomena are exhibited to the southern hemisphere as those already described in the case of the northern half of the earth. On the 22d of December the sun appears to touch the tropic of Capricorn, and is vertical to all those places on the earth that are 23½ degrees south of the equator. The days are then longest at all places in the southern hemisphere, but at the shortest in the northern. This time of the year is termed the *winter solstice*.

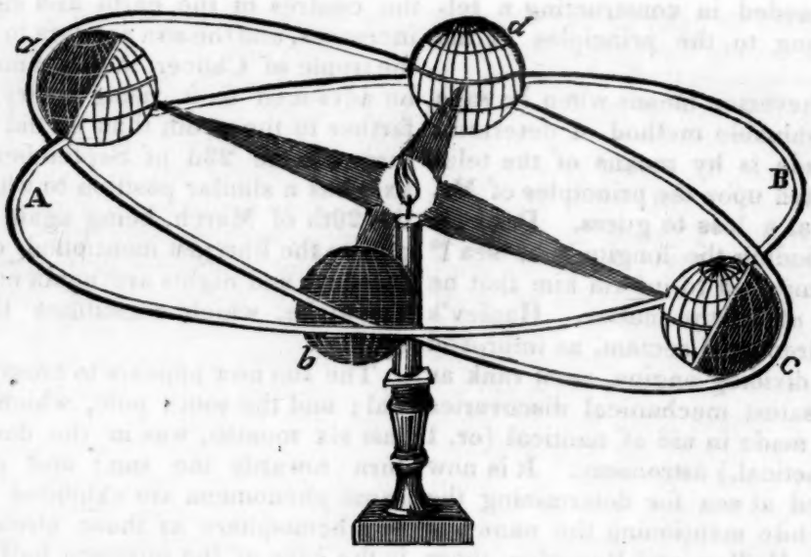
From the tropic of Capricorn the sun appears to move forward, and to arrive at the equinoctial on the 20th of March.

Thus, by a combination of the *annual* and diurnal motions of the earth, with the parallelism of its axis, and the obliquity of its orbit to the plane of its equator, the various seasons are produced, and the same quantity of light and darkness, in the space of a year, are distributed to every region of the globe.

The manner in which the sun enlightens the earth, the parallelism of its axis, and the increase and decrease of the days and nights, may be well illustrated by a small terrestrial globe, suspended by a string fastened to its north pole, as represented by the following figure. [See next page.]

A circle of wire, A B, representing the plane of the earth's equator, may be held parallel to a table, and equal in height with the flame of a candle standing upon it. If the string be twisted a little towards the left hand, and the globe suspended within the circle, with its equator at the same height, the globe will begin to turn on its axis from west to east, and day and night will be represented by the light and shade produced by the candle on its surface. But if the globe be carried round the wire, to represent a year, the candle will illuminate both poles, and every spot on its surface will describe half a circle in the enlightened part, and half in the dark part, and make equality

* The writer of this article has had considerable practice, both at sea and land, in taking and working lunar observations.



of day and night through the year. This is, however, not the case in nature, as has already been fully explained. If, then, the wire be inclined to the table at an angle of 23½ degrees, as represented by the circle *a b c d*, and the globe be carried gently round it, the seasons, and increase of day and night, will appear as they are in nature; that is, when the globe is at *a*, the candle enlightens it no farther northward than the arctic circle, *n o*, all within which, in the middle of our winter, is deprived of a sight of the sun, while all places within the antarctic or opposite circle have perpetual day: at this time the candle shines vertically on the tropic of Capricorn. As the earth moves towards *b* (the vernal equinox), if a small patch be laid on latitude 51½° north, it will show how the days increase at London, and how the nights decrease. When it has arrived at *b*, the candle will then be perpendicularly over the equator, and, shining to both poles, equality of day and night will take place: as it proceeds towards *c* (the summer solstice), the days increase, and the candle shines more and more over the north pole: when it has arrived at *c*, the whole arctic circle, and the countries it includes, will revolve in continual sight of the sun, and all within the antarctic circle will be deprived of that sight. At this time the candle shines vertically on the tropic of Cancer. Moving from midsummer towards *d* (the autumnal equinox), the days will be found to decrease, and the nights to increase in length, till they come again to equality at *d*, and thence to the winter solstice, and so on.

The particular temperature which distinguishes each of the seasons at any particular place is owing to a difference in the sun's altitude, and the time of his continuance above the horizon of that place. In winter the rays of the sun fall so obliquely, and the sun is such a short time above the horizon, that his influence in heating the earth is but very little, compared with what it is in summer. For at this season the sun is so much higher than in winter, that his rays not only fall more perpendicularly, but more of them fall on any given space; and as the day is also much longer than the night, the temperature of the earth and the surrounding atmosphere must be much greater than in winter.

Since the power of the sun is greater in heating the earth at any particular place, when his rays fall most directly, and when the days are longest at that place, it may be asked how does it happen that the heat is greatest about the end of July, when the sun is highest and the day longest about the 21st of June? The reason of this may easily be discovered by attending a little to the manner in which bodies are heated. The heat which the earth receives is not transient, but is retained by it for some time; for, like other solid bodies, it receives heat and parts with it gradually. Now, as the earth continues to receive more heat in the day than it gives out in the night, for a considerable time after the 21st of June, its temperature will continue to increase, till the days and nights begin to approach to an equality. But this is not the case till the end of July at least; the earth goes on increasing in temperature, till about this time,* when it is found to be much greater than about the 21st of June, although the sun be then higher at mid-day, and the day longer, than at any other time of the year in the

* The same phenomena takes place in the southern hemisphere in a reverse order, or at six months difference of time.

northern hemisphere. The heat in July would be still greater were the sun at his mean distance from the earth; but this is not the case, for he is then at his greatest distance. However, the difference between his distance at this time and the mean distance being only one sixty-fourth part of the whole, it could not make a great alteration in the heating power of the rays. But if it does operate in any degree in diminishing the heat in the northern hemisphere in July, the same cause must operate in increasing the heat, but in a double degree, in the southern hemisphere in January. For the sun is one sixty-fourth part nearer the earth than his mean distance on the 1st of January. Consequently the heat must be greater in the southern hemisphere in January than in the northern in July, all other circumstances being the same. The effect of the direct influence of the sun is, however, greatly modified by the transportation of the temperature of one region into another, in consequence of that disturbance in the equilibrium of the atmosphere which the action of the sun's rays necessarily produce.

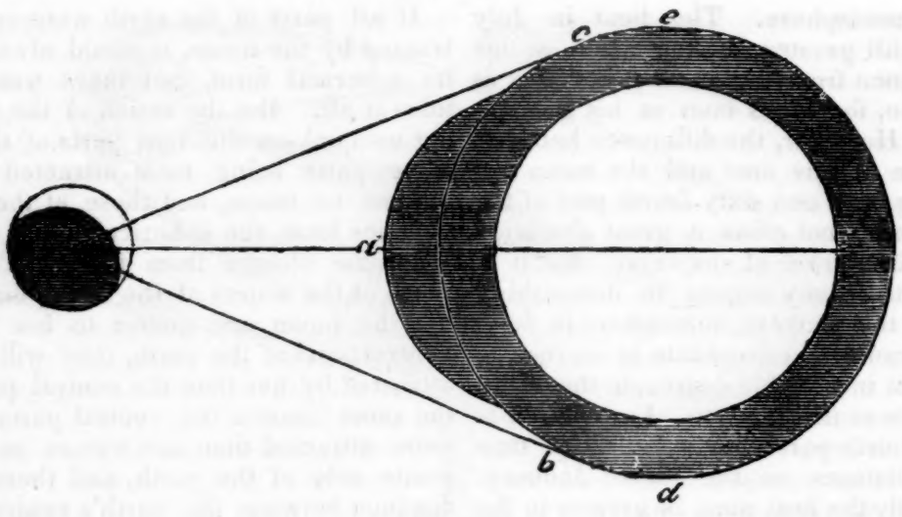
Thus we see by what simple means the whole variety of the seasons are produced; and also how admirably fitted the means are to accomplish the end.

Of the Tides.—The tides have always been found to follow, periodically, the course of the sun and moon; and hence it has been suspected, in all ages, that the tides were some way or other produced by these bodies.

The celebrated Kepler was the first person who formed any conjectures respecting their *true* cause. But what Kepler only hinted, has been completely developed and demonstrated by Sir Isaac Newton.

After his great discovery of the law of gravitation, he found it an easy matter to account for the whole phenomena of the tides; for, according to this law of nature, all the particles of matter which compose the universe, however remote from one another, have a continual tendency to approach each other, with a force directly proportional to the quantity of matter they contain, and inversely proportional to the square of their distance asunder. It is, therefore, evident from this, that the earth will be attracted both by the sun and moon. But although the attraction of the sun greatly exceeds that of the moon, yet, the sun being nearly four hundred times more distant from the earth than the moon, the *difference* of his attraction upon *different* parts of the earth is not nearly so great as that of the moon; and therefore the moon is the principal cause of the tides.

If all parts of the earth were equally attracted by the moon, it would always retain its spherical form, and there would be no tides at all. But the action of the moon being unequal on different parts of the earth, those parts being most attracted that are nearest the moon, and those at the greatest distance least, the spherical figure must suffer some change from the moon's action. Now, as the waters of the ocean directly under the moon are nearer to her than the central parts of the earth, they will be more attracted by her than the central parts. For the same reason the central parts will be more attracted than the waters on the opposite side of the earth, and therefore the distance between the earth's centre and the waters on its surface, both under the moon and on the opposite side, will be increased; or the waters will rise higher, and it will then be flood or high water at those places. But this is not the only cause that produces the rise of the waters at these two points; for those parts of the ocean which are 90° from them will be attracted with nearly the same force as the centres of the earth, the effect of which will be a small increase of their gravity towards the centre of the earth. Hence, the waters at those places will press towards the *zenith* and *nadir*, or the points where the gravity of the waters is diminished, to restore equilibrium, and thus occasion a greater rise at those points. But, in order to know the real effect of the moon on the ocean, the motion of the earth on its *axis* must be taken into account. For if it were not for this motion, the longest diameter of the watery spheroid would point directly to the moon's centre; but by reason of the motion of the whole mass of the earth on its axis, from west to east, the most elevated parts of the water no longer answer precisely to the moon, but are carried considerably to the eastward in the direction of the rotation. The waters also continue to rise after they have passed directly under the moon, though the immediate action to the moon begins there to decrease; and they do not reach their greatest height till they have got about 45° farther. After they have passed the point which is 90° distant from the point below the moon, they continue to descend, although the force which the moon adds to their gravity begins there to decrease. For still the action of the moon adds to their gravity and makes them descend till they have got about 45° farther; the greatest elevations, therefore, do not take place at the points which are in a line with the centres of the earth and moon, but about half a quadrant to the east

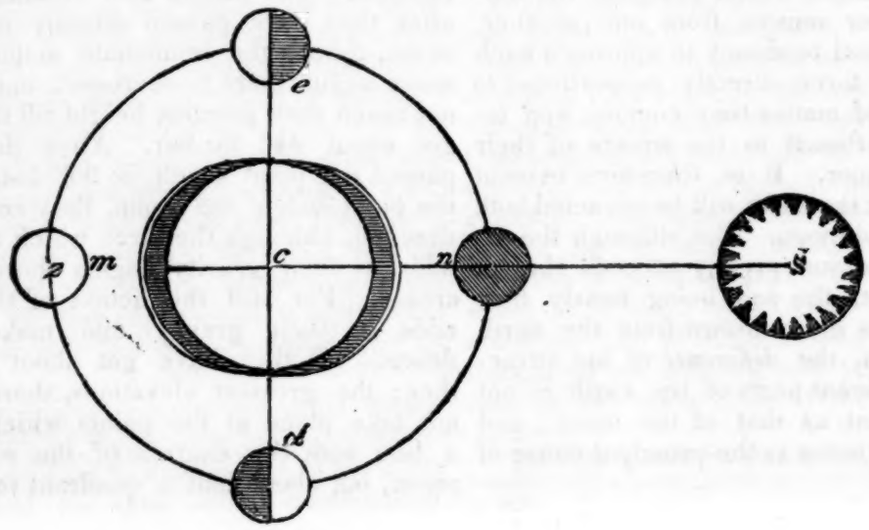


of these points, in the direction of the motion of rotation.

Thus it appears, if the earth were entirely covered by the ocean, as represented by the circle *b d e c* in the preceding figure, that the spheroidal form which it would assume would be so situated that its longest diameter would point to the east of the moon, or the moon would always be to the west of the meridian of the parts of greatest elevation. And as the moon apparently shifts her position from east to west in going round the earth every day, the longer diameter of the spheroid following her motions will occasion two floods and two ebbs in the space of a lunar day, or 24 hours 48 minutes.

These are the effects produced by the action of the moon only; but the sun has also a considerable effect on the waters of the ocean. But it is not the action of these bodies on the earth, but the inequalities of their actions, which produce these effects. The sun's action on the whole mass of the earth is much greater than of the moon's; but his distance is so great, that the diameter of the earth is a mere point compared with it; and therefore, the difference between his effects on the nearest and farthest side of the earth becomes on this account vastly less than it would be if the sun were as near as the moon. However, the immense bulk of the sun makes the effect still sensible, even at so vast a distance; and although the action of the moon has the greatest share in producing the tides, yet the action of the sun adds sensibly to this effect when his action is exerted in the same direction, as at the time of *new* and *full moon*, when these two bodies are nearly in the same straight line with the centre of the earth. When this is the case, the effects of these two bodies are united, so that the tides rise higher than at any other time, and are called *spring tides*, as represented by the following figure, where S denotes the sun, *d n e z* the moon, and *c* the earth.

The action of the sun diminishes that of the moon in the *quarters*, because his action is opposed to that of the moon; consequently the effect must be to depress the waters where the moon's action has a tendency to raise them. These tides are considerably



lower than at any other time, and are called *neap tides.*

The *spring tides* do not take place on the very day of the new and full moon, nor the neap tides on the very day of the quadratures, but a day or two after; because in this case, as in some others, the effect is neither the greatest nor least when the immediate influence of the cause is greatest or least: as the greatest heat, for example, is not on the solstitial day, when the immediate action of the sun is greatest, but some time after it. And although the action of the sun and moon were to cease, yet the ocean would continue to ebb and flow for some time, as its waves continue in violent motion for some time after a storm.

The *high water* at a given place does not always answer to the same situation of the moon, but happens sometimes sooner and sometimes later than if the moon alone acted on the ocean. This proceeds from the action of the sun not conspiring with that of the moon. The different distances of the moon from the earth also occasion a sensible variation in the tides.

When the moon approaches the earth, her action in every part increases, and the difference in that action, upon which the tides depend, likewise increases. For the attraction of any body is in the inverse ratio of the square of its distance; the nearer, therefore, the moon is to the earth, the greater is her attraction, and the more remote, the less. Hence, her action on the nearest parts increases more quickly than it does on the more remote parts, and therefore the tides increase in a higher proportion as the distance of the moon diminishes.

Sir Isaac Newton has shown that the tides increase as the cube of the distances decrease, so that the moon, at *half* her present distance, would produce a tide *eight times* greater. Now, the moon describes an ellipse about the earth, and, of course, must be once in every revolution nearer the earth than in any other part of her orbit; consequently, she must produce a much higher tide when in this point of her orbit than in the opposite point.

This is the reason that two great *spring tides* never take place immediately after each other; for if the moon be at her least distance at the time of new moon, she must be at her greatest distance at the time of *full moon*, having performed half a revolution in the intervening time, and therefore the spring tide at the *full* will be much less than that at the preceding *change*. For the same reason, if a great spring tide happens at the time of *full moon*, the tide at the following *change* will be less.

The spring tides are highest and the neap tides lowest about the beginning of the year; for the earth being nearest the sun about the 1st of January, must be more strongly attracted by that body than at any other time of the year; hence, the spring tides, which happen about that time, will be greater than at any other time. And should the moon be new or full in that part of her orbit which is nearest to the earth, at the same time the tides will be considerably higher than at any other time of the year.

The tide which happens at any time while the moon is above the horizon is called the *superior tide*, and the other the inferior tide. When the moon is in the equinoctial, other things remaining the same, the *superior* and inferior tides are of the *same* height; but when the moon declines towards the elevated pole, the *superior* tide is higher than the *inferior*. If the latitude of the place and the declination of the moon are of contrary names, the *inferior* tide will be the highest. But the highest tide at any particular place is when the moon's declination is equal to the latitude of the place, and of the same name; and the heighth of the tide diminishes as the difference between the latitude and declination increases; therefore, the nearer any place is to that parallel whose latitude is equal to the moon's declination, and of the same name, the higher will the tide be at that place.*

Such would the tides regularly be if the earth were all covered over with the ocean to a great depth; but as this is not the case, it is only at places situated on the shores of large oceans where such tides as above described take place.

The tides are also subject to very great irregularities from local circumstances, such as meeting with islands, shoals, headlands, passing through straits, &c. In order that they may have their full motion, the ocean in which they are produced ought to extend 90° from east to west, because that is the distance between the greatest elevation and the greatest depression produced in the waters by the moon. Hence it is that the tides in the Pacific Ocean exceed those of the Atlantic, and that they are less in that part of the Atlantic which is within the torrid zone between Africa and America, than in the temperate zones, on either side of it where the ocean is much broader.

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* In comparing the height of the tides at different places, it is supposed that the sun and moon are at the same distance from the earth, and in the same position with respect to the meridian of these places.

In the Baltic, the Mediterranean, and the Black seas, there are no sensible tides; for they communicate with the ocean by so narrow inlets, and are of so great extent, that they cannot speedily receive and let out water enough to raise or depress their surfaces in any sensible degree.

The power of the moon to raise the waters, Sir I. Newton has shown to be about 4½ times that of the sun, and that the moon raises the waters 8 feet 7 inches, while the sun and moon together raise them 10½ feet, when at their mean distances from the earth, and about 12 feet when the moon is at her least distance. These heights are found to agree very well with observations on the coasts of open and deep oceans, but not well on the coasts of small seas, and where the water is shallow.

The mean retardation of the tides, or of the moon's coming to the meridian in 24 hours, is 48′ 45″·7, and the mean interval between two successive tides is 12h. 25′ 14″·2; hence the mean daily retardation of high water is 50′ 28″·4.

About the time of *new* and *full* moon the interval is least, being only 12h. 19′ 28″; and at the quadratures the interval is the greatest, being 12h. 30′ 7″.

The common method of calculating the time of high water at any place is to multiply 50′ 28″, or the mean daily retardation of the tides, by the moon's age, and then to divide the product by 60, which gives the mean time of the moon coming to the meridian on that day in hours; to this is added the time of high water on the days of *full* and *change* at the given place, and the sum is the time of high water at that place on the *afternoon* of the given day, if the sum be less than 12 hours; but if greater, 12 hours 25 minutes must be subtracted, in order to have the time on the afternoon of the given day; and 25 minutes subtracted from this time will give the time of high water on the morning of the given day.*

The Study of Natural History in Common Schools.

A revolution of vast importance to the intellectual progress of children seems to have commenced in the common school system of the past age, both of this and some other favored countries, which introduces youth to an early acquaintance with the elements, at least, of a series of studies that were once unwisely supposed of no interest or consequence to them. That philosophy which provides resources for the active powers of the mind—which contemplates the physical organization of the body, and exerts a magnetic influence over the first independent inquiries of a human being, and, in its operations, elevates the character, and at the same time lays a broad and sure foundation for usefulness in this, and immortal happiness in another state of existence, must, indeed, recommend itself to every well-wisher of our race. Such seems to be the fact in relation to the new modes of action, which have resulted in a combined effort, certainly in New-England, to raise the standard of what is denominated a common education.

Children are by no means so destitute of thought as some may have ignorantly supposed; the machinery of their frames is no less in order for movement than their minds are vigorous and expansive. But to reduce the train to an orderly arrangement, and to direct those intellectual rays which, from the very structure of those organs through which external impressions are made, tend to aberrations, to luxuriance, and to monstrosity, calls upon the philanthropic instructor for uncommon exertions in the commencement of their pupilage.

Every man who has become at all interested in the prodigious efforts new making, for improving or perfecting the plan of early education, so auspiciously commenced, feels the necessity of superadding something else to the catalogue of indispensables to perfect the system, so that there is actual danger of building up an unwieldy and inconvenient edifice, that will, by and by, fall by the weight of its own massive materials. It is possible that we may be actuated by the same spirit of improvement which has been deprecated in others, as it is the principal object of this essay to call the attention of instructors to the consideration of a particular department of study, which has yet no place in the school. It belongs to one of those departments of knowledge which has employed the devoted talents of the greatest men, and in the sequel, irresistibly conducts the student from earth to things of heaven, and to Him who framed the universe. The subject to which this allusion is made is Natural History, not in its greatest latitude, embracing all animated nature, but a particular department of that curious and captivating subject, which explains the laws of animal life, the physiology and functions of individual organs, the habits, instincts, and localities of animals, and lastly, classification, by which is understood the reason for grouping them in tribes or families.

* This method is far from being exact; but affords an approximation, which may be useful on some occasions. When accuracy is wanted, recourse must be had to other methods.

That there will be objections to grafting this scion on the incipient tree of knowledge cannot be doubted; not because the subject is of an undignified or insignificant character, but from an apprehension that the capacities of children are incompetent to the investigation of such grave and all-absorbing topics. The food that recommends itself to the palate of the epicure, certainly, would not be invariably ungrateful to the less pampered appetite of a temperate liver. Enjoyment, arising from an accumulation of useful knowledge, surely cannot be less exciting to the child than to the profoundest philosopher of the age. Again: in what way can the child more readily become interested in the multitude of objects by which he finds himself surrounded, than by gratifying his natural desire for solving the why and the wherefore, in relation to the figure, economy, and propensities of those animals of which he entertains an instinctive fear? Even the infant is inquisitive to know why the dog has pointed teeth, or the cat sharp claws; why the bird has a bill and wings, instead of hands. Moreover, as the strength and majesty of the mind solely depends on its ceaseless activity in the right field of observation, something more than the pap of vulgar notions about giants and talking bears is indicated, in the present state of society, to prepare the intellectual faculties for receiving those solid, those truly substantial lessons which can alone fit the child for becoming a useful member of modern society.

In our happy times, muscular strength gives the individual no claim to admiration, with well-bred people; agility in wrestling, at tilts and tournaments, in daring feats of war, even when heroes are exhibited, have but an ephemeral applause; but the mighty achievements of the mind are enduring, and those who never reverenced one of their own species because he swayed a sceptre, have willingly paid homage to the superior moral and intellectual attainments of their fellow men.

It is principally because the elements of natural history are particularly captivating, from infancy to age, that the philosophical instructor should avail himself of its power to enlarge and strengthen the capacity of the child. Moreover, the study of this important branch of knowledge actually embraces within its circle, or calls in for illustration, most, if not all those sciences, the possession of which exalts man, and gives additional lustre to his intellectual character. Children are unsatisfied with the mere gratification of the eye. Though they may admire or be alarmed at the sight of beings whose physical organization differs essentially from their own, still an interrogatory follows. Who made it? where did it come from? will it bite? what does it eat? and whose is it? are the invariable questions that succeed any exhibition of animals, whose figure, or external characteristics, are not exceedingly familiar. Who will not acknowledge, then, if there is a branch of important information, useful and ennobling in riper years, so exciting to children, even in its crudest form—who would not admit the possibility of converting it into an instrument of singular force, which, while it amused, would also instruct, and give direction to those mental emanations so important to the well-being of society?

If the child is taught that there is a connecting link in the series of animated beings, and that the machinery by which the principle of life is sustained becomes more and more complicated as the series advances towards the physical perfectibility of man, it will assuredly exalt their ideas of the character of God, who demonstrates his omnipotency in calling them into existence, and his infinite skill, in adapting each family, however marvellous its configuration, to the precise condition of the locality it was expressly designed to occupy. It is idle to teach the child that 'order is heaven's first law,' without striking illustrations of the truth of the declaration. A pebble, a beautiful plant, or a star twinkling in the firmament, may each be referred to in explanation of the position, but they will fail to impress the dawning mind with any lasting remembrance of the Creator's power. But an animated being, moving its limbs, and showing its positive activity, independently of surrounding objects, never fails to develope the strongest interest. How can the principles of physiology, which treats expressly of the functions of individual organs, reach the understanding of children, without some correct information on the natural history of the common tribes of animals, including themselves! It were a waste of labor to make the attempt.

To produce the best results, and lay a permanent foundation for the study of natural history, in the case of children, it is obviously important to introduce them to the rudiments of anatomy. We would not be understood to leave the impression that any thing more than an approximation to that valuable science should be attempted. Thus, it might be said that all animals, for example, have bones, as the horse, the ox, dogs, and fishes; and subsequently, it should be men-

tioned that, although all animals have skeletons, some of them have their bones, or that which is equivalent, on the outside instead of the inside of their bodies, in the form of a shell, as, for example, the lobster, the oyster, and some others. Again, another preparatory step of more vital consequence than might at first be admitted, in the course of elementary education, is the fact, that it would be regarded, in the sequel, as highly curious, that every animal, whether large or small, has blood circulating through an almost infinite number of hollow tubes, laid like aqueduct pipes, all over their bodies. Bones, therefore, imply blood, because the one would never have been produced without the presence of the other. One of these simple truths exercises the mind, inasmuch as a reference is actually made to the other; hence comparison, and those modifications of primitive ideas, which eventuate in the production of a train of thought, and of knowledge, by the process of reasoning.

There being blood and bones, two essential constituents of an animal frame, it implies, in the third place, an organ in which the material of which both are constituted is elaborated. Here, then, it is necessary to explain the stomach, and, at the same time, show that it is a receptacle of food. Food, therefore, of whatever kind, being introduced into the stomach, is converted first into blood, and out of that the bones are formed. To these first impressions, the judicious instructor will append other remarks, explanatory of the first principles of vitality, but they should never pursue details that might rather confuse than enlighten the infantile mind. To know any thing certainly, all experience shows that the lesson should be a plain statement. Deductions naturally grow out of them, for such is the constitution of mind, whether in the babe or the philosopher, that it seeks out new sources of gratification, by revolving the primitive idea. Bones, &c. being necessary for animals, induces the child to exercise its latent reason, and it next arrives at this conclusion: Their limbs are inflexible, because there are bones in them; and the finger bleeds, because the blood is always running in the hollow vessel which has been wounded; animals eat, too, because some more blood must be manufactured, or else their bones would not grow, and so on. Such are the invariable operations of the child's mind, when the impetus has been given by any particular systematic course of instruction.—[Scientific Tracts.]

Mechanic Powers.—An experiment was made at Brussels on the 16th, at the house of the mechanician Lemaire, *rue de l'Eskylier*, No. 10, with a machine moved by a force not hitherto employed in mechanics. That force is Galvanism, which developes the magnetic property of iron. The new machine is composed of a flying (*volant*) horizontal wheel of copper, in the plane of which is placed a bar of iron, rendered magnetic by a galvanic pile. The bar carries round the wheel between two fixed magnets, but as soon as the ends of the bar reach the points of equilibrium, the electric current changes its relations, and replaces by repulsion the attraction which directs the bar. The latter, in consequence of the accelerated motion it has acquired, passes the position of equilibrium, and continues its rotary motion in the same direction. The experiment had complete success. The machine moved upwards of an hour, and its accelerated motion excited hopes that it may be ere long employed to move considerable masses. The great magnetic energy given to magnetism by a galvanic current is already well known, and be that, however, as it may, mechanics will henceforth be in possession of a new power. The machine, constructed with great care and success by Lemaire, was the invention of a Professor of Brussels, M. Guillery.—[Courrier Francaise, Aug. 4, 1834.]

It may be made a question, whether the machine put into operation at Brussels can, with strict propriety, be designated a new mechanic power, whatever may be the useful purposes to which it may be applied. The latter is, indeed, the only important subject of inquiry as regards that or any other invention or discovery.

Is there not a real and long known mechanic power, which has yet never been enumerated amongst those so entitled? We answer, there is such a power, and it is the pendulum. And more, the pendulum is the *power* of all others by which the greatest weight can be raised and moved by the least *force*. In many situations also, the pendulum could be applied to great effect, as, for instance, in stone quarries, in warehouses, to facilitate innumerable operations, in the lading and unlading vessels at wharves, &c.

Though simple in itself, very few persons reflect that in moving a pendulum, every point in it is actually raised, as the axis is a radius of a circle, the centre of which is the point of suspension. The pendulum again is a power admitting the aid indefinitely of accelerated motion, admitting, however, that moving on the principle of the sling, as the motion would be accelerated, a centrifugal

force would be produced in direct ratio with the rapidity given to the machine.

These hints on the pendulum are thrown out as recalled to the mind of the writer when translating the account of the Belgian machine, and may have been, and probably actually have been, suggested by others, as the subject seems too obvious not to have occupied minds engaged on the subject of mechanic forces.—[Nat. Intel.]

Spontaneous Combustion.—There is no science in which more wonders are displayed, or which is so intimately connected with every thing we do, as chemistry; the farmer, the painter, are indebted to chemistry—even the cook cannot boil a potato without chemistry having a hand in it: and there is hardly any branch of it more wonderful than that of spontaneous combustion, by which one or both of the bodies, either animate or inanimate, are consumed by fire, which is at times apparent, and at others not. Becker was the first who discovered the singular effect produced by mixing oil of vitriol (sulphuric acid) with oil of turpentine: he found that when the two perfectly cold liquids were mixed together (about a drachm each) they burst into a flame. Borrichois has, however, proved that aqua fortis produces the like effect; and it has since been discovered that spirits of nitre and sassafras elicit flame in a similar manner. Spirits of nitre, and any of the essential oils in bottles, ought therefore never to be kept together where they are likely to get broken, as they will infallibly inflame when they come in contact with each other. The quantity given for performing the experiment is one drachm of each; but it would require more of that which is sold in the shops, on account of its inferior quality. Every person is well acquainted with the most common existence of spontaneous combustion —that of stacks of corn or hay catching fire. If you ask a farmer why his stack caught fire, he will tell you, "Because it was carried too green;" in other words, because it was not sufficiently dry. But if you should ask him why its being carried too green occasioned its catching, (or firing, as it is termed,) he will be unable to tell you; but chemistry instructs us it is from the heat which is generated by the fermentation produced by the moisture or sap which it contained. Gunpowder magazines, paper-mills, barns, rag warehouses, &c. have frequently been burnt by the same principle—"spontaneous combustion." Another instance of it, not unknown to our readers, is the common fire boxes, such as the Promethean; and yet another, in every day practice, is the lately invented mode of obtaining light by pouring a jet of hydrogen gas on spongy platinum. The article is called by various names. In the windows of chemists may be seen a figure of a little comical looking old fellow, in bronze, on a piece of wood, placed on the top of a glass tube, about three inches in diameter, blowing through a tube from his mouth, with both his hands on a metal cap. The hydrogen gas is made by pouring an equal quantity of sulphuric acid and water on zinc. It was first invented by Professor Dobereiner, of Jena, in 1824. Galen informs us that pigeons' dung, when it has become rotten, will set fire to a house; and it is reported that the great church of Pisa was burnt down by the spontaneous combustion of the dung of pigeons, which had built there for centuries; but as very few of our readers have kept pigeons for a century, there cannot be much danger from that cause! Another instance of spontaneous combustion is that of powdered charcoal. No fewer than four cases of fire have occurred in France from that cause within the last thirty years; for when charcoal is reduced to powder by trituration in tuns with bronze bruisers, it is so fine that it has the appearance of an unctious fluid, and in that state occupies three times less room than in rods above six inches long. It absorbs air much more readily than in rods; this absorption, which is very slow, is accompanied by a disengagement of heat, which rises from 340° to 360° of Fahrenheit, and which is the true cause of the inflammation. But the most wonderful example is that of animal spontaneous combustion. There is an instance mentioned in the Transactions of the Society of Copenhagen, in 1692, of a woman of the lower class, who had been in the custom of drinking spirits to such an extent that she could hardly take any nourishment unless with a quantity of liquid. Having one night gone to sleep on a straw chair, she was discovered in the morning consumed so that no part was to be found, except the skull and the extreme joints of the fingers; all the rest of the body was reduced to ashes. John de Viana relates that the wife of Dr. Frielas, physician to the Cardinal de Royas, Archbishop of Toledo, emitted by perspiration an inflammable matter of such a nature, that when the ribband which she wore next to her person was taken from her and exposed to the air, it shot forth like grains of gunpowder. The Rev. Joseph Beamchini, prelate in the city of Verona, gives a very curious description of the Countess Cornelia Zangara, of Cesena, who was consumed by

an internal combustion in the sixty-second year of her age. He relates that she retired to bed as usual in perfect health, and in the morning was discovered by it consumed to ashes; her legs, with the stockings, remained unburnt, with the head half burnt lying between them, and the air in the room charged with floating soot. It was ascertained that when unwell she was in the habit of washing her body with camphorated spirits of wine. But these effects are not always confined to man; for in the time of the Roman consuls Gracchus and Juventius, a bull is said to have actually emitted flames from his nostrils without suffering any injury: and many more instances, too numerous to mention, place animal spontaneous combustion beyond a doubt; but, in general, it is found to occur in persons who have been addicted to drinking spirits.—[Literary Gazette.]

Telegraph Science. — The increasing utility of this very interesting science has become a subject of considerable notoriety. From an authenticated statement of the annual reports of the establishment at the observatory on Central wharf, in this city, the following results are communicated for the information of its numerous patrons.

Vessels telegraphed from 1824 to 1825, ...	799
" 1825 to 1826, ...	897
" 1826 to 1827, ...	923
" 1827 to 1828, ...	1010
" 1828 to 1829, ...	1309
" 1829 to 1830, ...	1435
" 1830 to 1831, ...	1583
" 1831 to 1832, ...	1809
" 1832 to 1833, ...	1856
" 1833 to 1834, ...	1922
Total number announced by telegraph, . . .	13,543

We understand that, during the above period, fifteen hundred sail of vessels, including the government vessels of war and the revenue cutters, have adopted the use of the telegraph flags.—[Scientific Tracts.]

Food.—By the experiments of Dr. Beaumont, it has been satisfactorily proved that from whatever is introduced into the stomach, the same article is invariably elaborated, whether animal or vegetable, tough or tender, it matters not; the result is the same, under all circumstances, when the digestive process is properly carried on. In the vicinity of Hudson's Bay, one of the exploring party, in those inhospitable regions, says he visited a cabin, one evening, when the inmates were at supper, which consisted of raw flesh of seals, fat, birds and entrails, which constituted a delicious meal. A young girl, the belle of the tribe, was sitting by, biting the inside of a seal to pieces, and distributing the bits to her companions. Train oil, particularly when rancid, is a delicious article, being both meat and drink for Greenlanders. Yet, it is worthy of remembrance, the chyme, the nutritious fluid which nourishes the body, is always the same, whether elaborated from putrid aliments or the most savory viands.—[Ibid.]

Schools in Siberia. — Lancasterian schools were established in Siberia by the late emperor Alexander, which are still well sustained. One thousand boys were taught in them, at the last accounts.—[Ibid.]

"The Society of Civil Engineers has obtained from the Crown a charter of incorporation,"

We have inserted the above notice, taken from the last number of the London Mechanics' Magazine, with the intention of devoting the editorial column of this week's paper to a consideration of the importance of a like institution to the cause of internal improvements in our own country.

In a conversation which the editor of this paper had some time since with one of our most scientific engineers, the question was asked, "Why is it that while the character and merit of the different works of Rennie, Telford, Stephenson, Vignoles, and other English engineers, are familiar to most of us here, nothing scarcely is known to them of works in this country, that would not suffer by a comparison with the best of those abroad?" He replied "We want a 'Society of Engineers,' with a suitable periodical to publish their proceedings; and until something of the kind is formed, we shall continue to labor under this disadvantage, that while the members of it have given ample evidence that there is an equal amount of talent and information in the profession here, but little credence will be given to the fact beyond the limited sphere of the directors and company of the work constructed." For the truth of our friend's remark, we can appeal with an honest pride to such works as the inclined planes of the Morris and the aqueducts of the Erie canals. The tunnels, planes, and viaducts of the Allegany Portage, and Baltimore and Ohio railroads, the hydraulic constructions of the Delaware and Raritan, and Delaware and Chesapeake canals, and the thousand other different works to be found on the numerous canals and railroads of our country. We have breakwaters, artificial harbors, aqueducts and reports on aqueducts, bridges, light-houses, dry docks, and wet docks; and, in fact, artificial constructions of every kind, inferior in boldness of conception or skill of execution to but very few of the boasted works of the English or French engineers. If, in a densely settled country like England, with every facility of visiting and becoming acquainted with each other's works, it has been found necessary for the preserva-

tion of the dignity of the profession, and for the dissemination of mutual experience, to form themselves into an incorporated society, how much the more does it become necessary for the profession here to adopt some similar measure. From the comparative paucity of their numbers, they are scattered over an immense section of country, and though, oftentimes two, three, or more works, may from their proximity be under the charge of one person, still from the progress of internal improvement in this country, the profession, from its inadequacy to supply the companies that are daily forming with suitable persons to construct their works, will be daily liable to abuse. Some enterprising carpenter or mason of the neighborhood, becoming possessed of a level and compass, styles himself an engineer, and is forthwith, for want of a better, employed by them as such. That some of our most distinguished engineers have commenced in a like manner, no one is more fully aware than ourselves, yet while, from sound judgment and great ability, they have been enabled to elevate themselves to the highest standing, we are constrained to regard them only as glorious exceptions to the general rule. If the remark is not applicable as a general rule to those who thus commence, why is it, we would ask, that, young as our country is, we already have to lament ver so many abortive experiments?

If such an institution as a "Society of Civil Engineers" existed among us, our companies would, as a matter of course, look to its members as the proper persons to which to entrust the charge of their several works. Those entering the profession would naturally connect themselves with some one engineer whose reputation for ability would thus become publicly known, and under whom they could attain that information and experience which would in turn enable them to supply the places that must one day become vacant. That an efficient remedy for the evils we previously stated would be found in such an institution, we firmly believe, and in that belief would cheerfully open our columns for communications on the subject; and as an ardent advocate of the cause of internal improvement, we pledge ourselves that no exertion shall be wanting on our part, that might conduce to carry into effect a measure in which we think the best interests of that cause are so deeply concerned.—[American Railroad Journal.]

Steam Carriages on Common Roads.

UTICA, N. Y., Sept. 26, 1834.

To the Editor of the Railroad Journal:

DEAR SIR,—I take the liberty of sending you for publication, if you think proper, in the Railroad Journal, an extract from a letter just received from a friend in Europe, communicating information upon the important subjects of the explosion of steam boilers and the application of steam to locomotion on common roads. The remarks of the writer are deserving of the more attention, as they are subjects with which he is practically acquainted, and to which for the last few years he has devoted much study and observation. His interview with Mr. Perkins will be read with interest, not only from the high reputation which Mr. P. has acquired as an artist, but from the general success of his labors, in developing the powers and properties of steam, and in various other improvements in science and the arts.

With respect, yours, truly, E. F. J.

"PARIS, August 2, 1834.

"I made considerable inquiry (as you requested) with regard to the application of steam carriages to common roads while in England, but regret that I am not able to give you as favorable an account of the late improvements as you may possibly anticipate.

"You have probably seen the statement published in the London Times some months since, that a carriage, in operation near there, had passed the Royal Mail while ascending at full speed a hill of considerable elevation, and that it had travelled at the rate of 24 miles per hour on a level. You must not, however, conclude that the use of steam is driving the horses from the English turnpikes. The arbitrary coachman has not yet been compelled to abdicate his throne in favor of the more skilful engineer, who has been trained to load a safety valve in lieu of the cockney accomplishment of guiding by the rein or cracking the whip.

"The great weight which, notwithstanding the numerous improvements, is still found indispensable to an engine and boiler of any considerable power, renders it almost impossible to mount it upon wheels, and continue it in rapid motion for any length of time, on as irregular a surface as that of a common road, without serious injury. It must be considered likewise that the effect produced by a given power is small, compared with that upon a well constructed railway, owing to the greater resistance to be overcome, arising from the irregularity of the surface above mentioned.

"Mr. Church's patent steam carriage, constructed to ply between Birmingham and London, is one of the lightest in proportion to its strength, and I think of the best arrangement of any that I had an opportunity of seeing. It has two oscillating cylinders of 50 horse power each, and a small extra engine for supplying the boiler with water when the carriage is at rest. The whole machine weighs four tons, and performs admirably for a short distance, but is subject to the difficulty I have already mentioned. *It is now, like all the others, laid up for repair.*

"Mr. Ericsson (of whom you speak) has not as yet been able, I believe, to prove by actual experiment the advantages of his boiler for using air instead of water for generating power. I sent you from London a number of the Repertory, containing the specification of his patent, and I have not learned that he has made any important improvement since.

"There is a great difference of opinion with regard to the ultimate success of steam carriages among the knowing ones in England. Mr. Church is very confident of success, and is

expending very large sums in experimenting, while Mr. Perkins is of a different opinion. He thinks that very great improvements must yet be made, not only in the boiler, but in the engine, before steam carriages can be applied with any advantage to common roads. He is now experimenting on a rotary steam engine invented by some lord, whose name I have forgotten, which he wishes to apply to the railroad carriage. You know what my views have been on the application of the rotary engine to locomotion for some time past. Pardon my vanity, but I do think the model I showed you some years since is much less liable to friction, and I know less complicated, than his lordship's. The latter moves, however, under the hand of Mr. Perkins, but whether it will economize steam the most, is another question.

"Speaking of Mr. Perkins reminds me of a conversation I had with him a few days before leaving London, on the subject of steam boilers and explosions. He agrees with me in opinion that the theory of collapses is false, and that explosions only occur from the application of too great a pressure, (caused either by too great a reduction of water in the boiler, or by not using the steam as rapidly as it should be,) or from the combustion of a mixture of hydrogen and oxygen gases. He told me that he was perfectly convinced, from recent experiments, that if explosions did occur in the use of his high pressure boiler from the first two causes, no serious consequences would ensue. As a proof of this assertion, he produced several fragments of a boiler, which had been attached to his steam-gun, and which had exploded several times at a pressure of from 400 lbs. to 600 lbs. to the square inch, without injury to the engineer or any of the attendants, or without deranging any part of the machine, except the particular flue, or rather cylinder or tube, that gave way, and which in every case was repaired in one night and ready for action again the next morning.

"He also thinks he has discovered how the oxygen is supplied, which, combined with hydrogen, has produced, beyond a doubt, so many dreadful explosions of the low pressure boilers in our country. You are aware that the disbelievers in the theory of explosions by the combination of gases have founded their faith on the impossibility that any oxygen gas should exist in the boiler. They say that it is impossible for it to find its way there against the pressure of the steam, and that although hydrogen might be formed by the decomposition of the water, yet oxygen could not be. Mr. P. perfectly explains it. It is supplied by the force pump, which, in almost all the American steamboats, is constructed in such a manner as to force in air when it is no longer able to supply water. The water being low, the iron is exposed to the action of the fire, soon becomes red hot, throws off hydrogen, and when a certain quantity of each is produced, the boiler is as certain to explode, as though, when thus heated, it were filled with gunpowder. This, too, explains the reason why the number of explosions in England are so few in proportion to those in the United States. It is not because they have more skilful engineers, or that they are more careful, but because their force pumps are immersed, almost universally, in water, (not from design, but by accident.) They therefore cannot force air into the boiler, although they may not supply it with water. The subject certainly deserves attention. If, by using a boiler like that of Mr. Perkins', the risk of life occasioned by the ordinary explosions can be greatly or entirely diminished, and if, by immersing the force pump in water, the explosion of gases can be entirely prevented, the experiment should be fairly and fully tried.

"I intended to have given you, as well as I was able, a description of the Galley of Practical Arts, in which Mr. P.'s steam gun is placed, which discharges 36 balls per second, and where his press is deposited, with which he compresses water one-twelfth of its bulk. I wished also to speak of his late discovery of making ice at 4 cents per lb., by which he is enabled to produce it at sea to supply the place of fresh water, and to undersell the Boston merchant who ships it to the south, but must defer it to another opportunity; and will close by saying that I leave here to-day in a small paid Diligence, with the prospect of being stopped to show my passport every few miles—the police being particularly strict since Don Carlos passed them so rapidly the other day.

"Yours, as ever, W———."

Canal of Burgundy.—The line of internal navigation, which this magnificent undertaking has at last completed, extends from Havre de Grace to Marseilles, and is of the length of 300 leagues and upwards. It was commenced by the states of Burgundy in the year 1775, continued during the imperial sway of Bonaparte, and resumed in the year 1822. The whole sum expended upon it, from first to last, amounted to 40,000,000 francs, (£1,000,000.) Its actual length from St. Jean de Losne to the village of La Roche, where it meets the Yonne, is 242,-572 metres, or 795,830 feet. It is provided with 189 sluices.

A Canal uniting the Rhine with the Rhone, and 246,000 metres (or 807,085 feet) in length, has likewise been opened; it begins at St. Symphorien, where it joins the Saone, and passes into the Rhine at a village called Kilstett, near Strasburg. It has also a branch leading from Mulhausen to Basle. The expense of constructing this canal was much less than that of the canal of Burgundy, as there were fewer difficulties to overcome in forming it.—[English paper.]

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